Tetra Tech, Inc.
DATA VALIDATION REPORT
LEVEL II

Site:	West Lake Landfill Site, Bridgeton, Missouri
Laboratory:	TestAmerica Laboratories, Inc. (Earth City, Missouri)
Data Reviewer:	Harry Ellis, Tetra Tech, Inc. (Tetra Tech)
Review Date	August 21, 2014
Sample Delivery Group (SDG):	J7447
Sample Numbers:	WAA-01-AF-PS-20140710, WAA-02-AF-PS-20140710, WAA-03-AF-PS-20140710, WAA-04-AF-PS-20140710, WAA-05-AF-PS-20140710 and WAA-00-AF-TB-20140710
Matrix / Number of Samples:	5 Air Samples and 1 Trip Blank

The data were qualified according to the U.S. Environmental Protection Agency (EPA) Region 7 documents entitled "Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review" (9240.1-48), June 2008. In addition, the Tetra Tech document "Review of Data Packages from Subcontracted Laboratories" (February 2002) and the EPA and others document "Multi-Agency Radiological Laboratory Analytical Protocols Manual" (July 2004) were used along with other criteria specified in the applicable methods.

The review was intended to identify problems and quality control (QC) deficiencies that were readily apparent from the summary data package. The following sections discuss any problems or deficiencies that were found, and data qualifications applied because of non-compliant QC. The data review was limited to the available field and laboratory QC information submitted with the project-specific data package.

I, Harry Ellis, certify that all data validation criteria outlined in the above-referenced documents were assessed, and any qualifications made to the data accorded with those documents.

Harry N. Ellis III

21 August 2014

Certified by Harry Ellis, Chemist — Date

DATA VALIDATION QUALIFIERS

U — The analyte was not detected above the reported sample quantitation limit.

J — The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

UJ — The analyte was not detected above the reported sample quantitation limit, which is estimated.

R — The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet QC criteria. Presence or absence of the analyte cannot be verified.

DATA ASSESSMENT

Sample delivery group (SDG) J7447 included five (5) environmental air (filter) samples and one (1) QC sample (a field blank). Samples were analyzed for total alpha-emitting radium by EPA SW-846 Method 9315 and for isotopic (alpha-emitting) thorium and radium by Department of Energy (DOE) Method A-01-R. The following summarizes the data validation that was performed.

RADIOANALYTICAL ANALYSES

I. Holding Time and Chain of Custody (COC) Requirements

The samples were received by the laboratory and analyzed within the established holding time of 6 months from sample collection to analysis. No data were qualified.

II. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

Insufficient sample was available for MS/MSD analyses. Duplicate LCS analysis provided adequate data on precision and accuracy. No qualifications were applied.

III. Blanks

The laboratory (method) blank yielded low activities for two of three thorium isotopes and no uranium isotopes, while the field blank yielded low activities for the same two thorium isotopes and all three uranium isotopes.. These blank activities were similar to those seen in the other field samples. No qualifications were applied.

IV. Laboratory Control Sample (LCS)

All percent recoveries and the relative percent differences from the duplicate LCS analyses were within established control limits. No qualifications were applied.

V. Surrogates

These radioanalytical methods use a "carrier" or "tracer", whose recovery serves the same functions as surrogate recoveries. All carrier and tracer recoveries were within the laboratory's QC limits.

VI. Comments

All detected results for thorium and uranium were less than their reporting limits ("RL"). These extrapolations should be qualified as estimated (flagged "J"). The total alpha radium results had minimum detectable concentrations (MDC) near the RL due to small sample size; one sample (WAA-03-AF-PS-20140710) had an MDC above the RL. The one detected result, from sample WAA-02-AF-PS-20140710, was barely above its MDC and is also qualified as estimated.

VII. Overall Assessment of Data

Overall data quality is acceptable, with few qualifications applied. All data are usable as qualified for their intended purposes.

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

ANALYTICAL REPORT

TestAmerica Laboratories, Inc.
TestAmerica St. Louis
13715 Rider Trail North
Earth City, MO 63045
Tel: (314)298-8566

TestAmerica Job ID: 160-7447-1
Client Project/Site: West Lake Landfill - Filters

For:
Tetra Tech EM Inc.
415 Oak Street
Kansas City, Missouri 64106

Attn: Ms. Emily Fisher

Authorized for release by:
8/11/2014 11:21:07 AM

Erika Gish, Project Manager II
(314)298-8566
erika.gish@testamericainc.com

This report has been electronically signed and authorized by the signatory. Electronic signature is intended to be the legally binding equivalent of a traditionally handwritten signature.

Results relate only to the items tested and the sample(s) as received by the laboratory.

Table of Contents

Job ID: 160-7447-1

Laboratory: TestAmerica St. Louis

Narrative

CASE NARRATIVE

Client: Tetra Tech EM Inc.

Project: West Lake Landfill - Filters

Report Number: 160-7447-1

With the exceptions noted as flags or footnotes, standard analytical protocols were followed in the analysis of the samples and no problems were encountered or anomalies observed. In addition all laboratory quality control samples were within established control limits, with any exceptions noted below. Each sample was analyzed to achieve the lowest possible reporting limit within the constraints of the method. In some cases, due to interference or analytes present at high concentrations, samples were diluted. For diluted samples, the reporting limits are adjusted relative to the dilution required.

TestAmerica St. Louis attests to the validity of the laboratory data generated by TestAmerica facilities reported herein. All analyses performed by TestAmerica facilities were done using established laboratory SOPs that incorporate QA/QC procedures described in the application methods. TestAmerica's operations groups have reviewed the data for compliance with the laboratory QA/QC plan, and data have been found to be compliant with laboratory protocols unless otherwise noted below.

The test results in this report meet all NELAP requirements for parameters for which accreditation is required or available. Any exceptions to NELAP requirements are noted in this report. Pursuant to NELAP, this report may not be reproduced, except in full, without the written approval of the laboratory.

Calculations are performed before rounding to avoid round-off errors in calculated results.

All holding times were met and proper preservation noted for the methods performed on these samples, unless otherwise detailed in the individual sections below.

All solid sample results for Chemistry analyses are reported on an "as received" basis unless otherwise indicated by the presence of a % solids value in the method header. All soil/sediment sample results for radiochemistry analyses are based upon sample as dried and disaggregated with the exception of tritium, carbon-14, and iodine-129 by gamma spectroscopy unless requested as wet weight by the client."

This laboratory report is confidential and is intended for the sole use of TestAmerica and its client.

RECEIPT

The samples were received on 7/14/2014 1:10 PM; the samples arrived in good condition, properly preserved and, where required, on ice. The temperature of the cooler at receipt was 21.4° C.

TOTAL ALPHA RADIUM (GFPC)

Samples WAA-01-AF-PS-20140710 (160-7447-1), WAA-02-AF-PS-20140710 (160-7447-2), WAA-03-AF-PS-20140710 (160-7447-3), WAA-04-AF-PS-20140710 (160-7447-4), WAA-05-AF-PS-20140710 (160-7447-5) and WAA-00-AF-FB-20140710 (160-7447-6) were analyzed for Total Alpha Radium (GFPC) in accordance with SW- 846 Method 9315. The samples were prepared on 07/22/2014 and analyzed on 07/23/2014.

Insufficient sample volume was available to perform a matrix spike/matrix spike duplicate/sample duplicate (MS/MSD/DUP). The samples are filters that must be split between multiple analysis. A LCS/LCSD was used instead: WAA-00-AF-FB-20140710 (160-7447-6), WAA-01-AF-PS-20140710 (160-7447-1), WAA-02-AF-PS-20140710 (160-7447-2), WAA-03-AF-PS-20140710 (160-7447-3), WAA-04-AF-PS-20140710 (160-7447-4), WAA-05-AF-PS-20140710 (160-7447-5).

Job ID: 160-7447-1 (Continued)

Laboratory: TestAmerica St. Louis (Continued)

The total alpha emitting radium detection goal was not met for the following samples due to insufficient sample available for analysis; samples are filters and were split among other analyses: (LCS 160-133148/2-A), (LCSD 160-133148/3-A), WAA-03-AF-PS-20140710 (160-7447-3). Analytical results are reported with the detection limit achieved.

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No additional analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

ISOTOPIC THORIUM (ALPHA SPECTROMETRY)

Samples WAA-01-AF-PS-20140710 (160-7447-1), WAA-02-AF-PS-20140710 (160-7447-2), WAA-03-AF-PS-20140710 (160-7447-3), WAA-04-AF-PS-20140710 (160-7447-4), WAA-05-AF-PS-20140710 (160-7447-5) and WAA-00-AF-FB-20140710 (160-7447-6) were analyzed for Isotopic Thorium (Alpha Spectrometry) in accordance with A-01-R. The samples were prepared on 07/22/2014 and analyzed on 07/28/2014.

Insufficient sample volume was available to perform a matrix spike/matrix spike duplicate/sample duplicate (MS/MSD/DUP). The samples are filters that must be split between multiple analysis. A LCS/LCSD was used instead: WAA-00-AF-FB-20140710 (160-7447-6), WAA-01-AF-PS-20140710 (160-7447-1), WAA-02-AF-PS-20140710 (160-7447-2), WAA-03-AF-PS-20140710 (160-7447-3), WAA-04-AF-PS-20140710 (160-7447-4), WAA-05-AF-PS-20140710 (160-7447-5).

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No additional analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

ISOTOPIC URANIUM (ALPHA SPECTROMETRY)

Samples WAA-01-AF-PS-20140710 (160-7447-1), WAA-02-AF-PS-20140710 (160-7447-2), WAA-03-AF-PS-20140710 (160-7447-3), WAA-04-AF-PS-20140710 (160-7447-4), WAA-05-AF-PS-20140710 (160-7447-5) and WAA-00-AF-FB-20140710 (160-7447-6) were analyzed for Isotopic Uranium (Alpha Spectrometry) in accordance with A-01-R. The samples were prepared on 07/22/2014 and analyzed on 07/28/2014.

Insufficient sample volume was available to perform a matrix spike/matrix spike duplicate/sample duplicate (MS/MSD/DUP). The samples are filters that must be split between multiple analysis. A LCS/LCSD was used instead: WAA-00-AF-FB-20140710 (160-7447-6), WAA-01-AF-PS-20140710 (160-7447-1), WAA-02-AF-PS-20140710 (160-7447-2), WAA-03-AF-PS-20140710 (160-7447-3), WAA-04-AF-PS-20140710 (160-7447-4), WAA-05-AF-PS-20140710 (160-7447-5).

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No additional analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

TestAmerica St. Louis
13715 Rider Trail North

Earth City, MO 63045
phone 314.298.8566 fax

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TestAmerica Laboratories, Inc.

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

Client Contact	Project Manager: Dave Kinroth	Site Contact: Dave Kinroth	Date: 7-14-14	COC No:
Tetra Tech, Inc.	Tel/Fax: 314-517-6798	Lab Contact:	Carrier:	1 of 1 COCs
415 Oak Street	Analysis Turnaround Time			Sampler:
Kansas City, MO 64106	☐ CALENDAR DAYS ☐ WORKING DAYS			For Lab Use Only:
(816) 412-1786 Phone	TAT if different from Below _____			Walk-in Client:
(816) 816-410-1748 FAX	☐ 2 weeks			Lab Sampling:
Project Name: West Lake Landfill Site	☐ 1 week			
Site: Bridgeton, MO	☐ 2 days			Job / SDG No.:
P O # 1105610	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	9310 Gross Alpha/Beta	GA-01-R Gamm Spec	9315 Total Alpha Radium	A-01-R Isotopic Thorium	A-01-R Isotopic Uranium	* 9315 Radium-226 (GFPC)	Sample Specific Notes:
WAA-01-AF-PS-20140710	7/10/14	15:55	Filter	Air	1			X	X	X	X	X	X	* 9315 Radium-226 (GFPC)
WAA-02-AF-PS-20140710	7/10/14	14:16	Filter	Air	1			X	X	X	X	X	X	contingent upon TAR results
WAA-03-AF-PS-20140710	7/10/14	12:53	Filter	Air	1			X	X	X	X	X	X	for all samples
WAA-04-AF-PS-20140710	7/10/14	13:51	Filter	Air	1			X	X	X	X	X	X	
WAA-05-AF-PS-20140710	7/10/14	14:51	Filter	Air	1			X	X	X	X	X	X	
WAA-00-AF-FB-20140710	7/10/14	NA	Filter	Air	1			X	X	X	X	X	X	

160-7447 Chain of Custody

Preservation Used: 1= Ice, 2= HCl, 3= H2SO4, 4=HNO3, 5=NaOH, 6= Other

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.

☑ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)

☐ Return to Client ☐ Disposal by Lab ☐ Archive for _____ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No	Custody Seal No.:		Cooler Temp. (°C): Obs'd: _____ Corr'd: _____	Therm ID No.: _____	
Relinquished by:	Company: STL	Date/Time: 7-14-14 1310	Received by:	Company: TASTL	Date/Time: 7-14-14 1310
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

Form No. CA-C-WI-002, Rev. 4.3, dated 12/05/2013

Login Sample Receipt Checklist

Client: Tetra Tech EM Inc.

Job Number: 160-7447-1

Login Number: 7447
List Number: 1
Creator: Clarke, Jill C

List Source: TestAmerica St. Louis

Question	Answer	Comment
Radioactivity wasn't checked or is </= background as measured by a survey meter.	True	
The cooler's custody seal, if present, is intact.	N/A	
Sample custody seals, if present, are intact.	True	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	N/A	
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
Is the Field Sampler's name present on COC?	N/A	
There are no discrepancies between the containers received and the COC.	True	
Samples are received within Holding Time.	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
Sample Preservation Verified.	True	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
Containers requiring zero headspace have no headspace or bubble is <6mm (1/4").	N/A	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Residual Chlorine Checked.	N/A	

Qualifiers

Rad

Qualifier	Qualifier Description
U	Result is less than the sample detection limit.
G	The Sample MDC is greater than the requested RL.

Glossary

Abbreviation	These commonly used abbreviations may or may not be present in this report.
¤	Listed under the "D" column to designate that the result is reported on a dry weight basis
%R	Percent Recovery
CFL	Contains Free Liquid
CNF	Contains no Free Liquid
DER	Duplicate error ratio (normalized absolute difference)
Dil Fac	Dilution Factor
DL, RA, RE, IN	Indicates a Dilution, Re-analysis, Re-extraction, or additional Initial metals/anion analysis of the sample
DLC	Decision level concentration
MDA	Minimum detectable activity
EDL	Estimated Detection Limit
MDC	Minimum detectable concentration
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
NC	Not Calculated
ND	Not detected at the reporting limit (or MDL or EDL if shown)
PQL	Practical Quantitation Limit
QC	Quality Control
RER	Relative error ratio
RL	Reporting Limit or Requested Limit (Radiochemistry)
RPD	Relative Percent Difference, a measure of the relative difference between two points
TEF	Toxicity Equivalent Factor (Dioxin)
TEQ	Toxicity Equivalent Quotient (Dioxin)

Method Summary

Client: Tetra Tech EM Inc.
Project/Site: West Lake Landfill - Filters

TestAmerica Job ID: 160-7447-1

Method	Method Description	Protocol	Laboratory
9315	Total Apha Radium (GFPC)	SW846	TAL SL
A-01-R	Isotopic Thorium (Alpha Spectrometry)	DOE	TAL SL
A-01-R	Isotopic Uranium (Alpha Spectrometry)	DOE	TAL SL

Protocol References:

DOE = U.S. Department of Energy

SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

Laboratory References:

TAL SL = TestAmerica St. Louis, 13715 Rider Trail North, Earth City, MO 63045, TEL (314)298-8566

Sample Summary

Client: Tetra Tech EM Inc.
Project/Site: West Lake Landfill - Filters

TestAmerica Job ID: 160-7447-1

Lab Sample ID	Client Sample ID	Matrix	Collected	Received
160-7447-1	WAA-01-AF-PS-20140710	Filter	07/10/14 15:55	07/14/14 13:10
160-7447-2	WAA-02-AF-PS-20140710	Filter	07/10/14 14:16	07/14/14 13:10
160-7447-3	WAA-03-AF-PS-20140710	Filter	07/10/14 12:53	07/14/14 13:10
160-7447-4	WAA-04-AF-PS-20140710	Filter	07/10/14 13:51	07/14/14 13:10
160-7447-5	WAA-05-AF-PS-20140710	Filter	07/10/14 14:51	07/14/14 13:10
160-7447-6	WAA-00-AF-FB-20140710	Filter	07/10/14 00:00	07/14/14 13:10

Client Sample Results

Client: Tetra Tech EM Inc
Project/Site: West Lake Landfill - Filters

TestAmerica Job ID: 160-7447-1

Client Sample ID: WAA-01-AF-PS-20140710
Date Collected: 07/10/14 15:55
Date Received: 07/14/14 13:10

Lab Sample ID: 160-7447-1
Matrix: Filter

Method: 9315 - Total Apha Radium (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Total Alpha Radium	0.274	U	0.468	0.469	1.00	0.816	pCi/Sample	07/22/14 15:40	07/23/14 15:44	1

Carrier	%Yield	Qualifier	Limits	Prepared	Analyzed	Dil Fac
Ba Carrier	101		40 - 110	07/22/14 15:40	07/23/14 15:44	1

Method: A-01-R - Isotopic Thorium (Alpha Spectrometry)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Thorium-228	0.277	J	0.119	0.122	1.00	0.147	pCi/Sample	07/22/14 11:27	07/28/14 15:25	1
Thorium-230	0.437	J	0.116	0.122	1.00	0.0231	pCi/Sample	07/22/14 11:27	07/28/14 15:25	1
Thorium-232	0.0613	J	0.0485	0.0488	1.00	0.0587	pCi/Sample	07/22/14 11:27	07/28/14 15:25	1

Tracer	%Yield	Qualifier	Limits	Prepared	Analyzed	Dil Fac
Thorium-229	95.1		30 - 110	07/22/14 11:27	07/28/14 15:25	1

Method: A-01-R - Isotopic Uranium (Alpha Spectrometry)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Uranium-233/234	0.161	J	0.0812	0.0823	1.00	0.0811	pCi/Sample	07/22/14 11:27	07/28/14 15:29	1
Uranium-235/236	0.0105	U	0.0211	0.0211	1.00	0.0316	pCi/Sample	07/22/14 11:27	07/28/14 15:29	1
Uranium-238	0.0676	J	0.0478	0.0481	1.00	0.0254	pCi/Sample	07/22/14 11:27	07/28/14 15:29	1

Tracer	%Yield	Qualifier	Limits	Prepared	Analyzed	Dil Fac
Uranium-232	86.3		30 - 110	07/22/14 11:27	07/28/14 15:29	1

Client Sample ID: WAA-02-AF-PS-20140710
Date Collected: 07/10/14 14:16
Date Received: 07/14/14 13:10

Lab Sample ID: 160-7447-2
Matrix: Filter

Method: 9315 - Total Apha Radium (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Total Alpha Radium	1.11	J	0.638	0.645	1.00	0.864	pCi/Sample	07/22/14 15:40	07/23/14 15:45	1

Carrier	%Yield	Qualifier	Limits	Prepared	Analyzed	Dil Fac
Ba Carrier	100		40 - 110	07/22/14 15:40	07/23/14 15:45	1

Method: A-01-R - Isotopic Thorium (Alpha Spectrometry)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Thorium-228	0.239	J	0.121	0.122	1.00	0.162	pCi/Sample	07/22/14 11:27	07/28/14 15:25	1
Thorium-230	0.413	J	0.115	0.120	1.00	0.0597	pCi/Sample	07/22/14 11:27	07/28/14 15:25	1
Thorium-232	0.0231	J	0.0266	0.0267	1.00	0.0231	pCi/Sample	07/22/14 11:27	07/28/14 15:25	1

HVE 21 August 2014

TestAmerica St. Louis

Client Sample ID: WAA-02-AF-PS-20140710

Lab Sample ID: 160-7447-2
Matrix: Filter

Date Collected: 07/10/14 14:16
Date Received: 07/14/14 13:10

Tracer	%Yield	Qualifier	Limits	Prepared	Analyzed	Dil Fac
Thorium-229	95.4		30 - 110	07/22/14 11:27	07/28/14 15:25	1

Method: A-01-R - Isotopic Uranium (Alpha Spectrometry)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Uranium-233/234	0.0686	U	0.0594	0.0597	1.00	0.0822	pCi/Sample	07/22/14 11:27	07/28/14 15:29	1
Uranium-235/236	0.0320	U	0.0477	0.0478	1.00	0.0817	pCi/Sample	07/22/14 11:27	07/28/14 15:29	1
Uranium-238	0.0856	J	0.0593	0.0598	1.00	0.0655	pCi/Sample	07/22/14 11:27	07/28/14 15:29	1

Tracer	%Yield	Qualifier	Limits	Prepared	Analyzed	Dil Fac
Uranium-232	83.6		30 - 110	07/22/14 11:27	07/28/14 15:29	1

Client Sample ID: WAA-03-AF-PS-20140710

Lab Sample ID: 160-7447-3
Matrix: Filter

Date Collected: 07/10/14 12:53
Date Received: 07/14/14 13:10

Method: 9315 - Total Alpha Radium (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Total Alpha Radium	0.330	U	0.664	0.664	1.00	1.15	pCi/Sample	07/22/14 15:40	07/23/14 15:45	1

Carrier	%Yield	Qualifier	Limits	Prepared	Analyzed	Dil Fac
Ba Carrier	99.7		40 - 110	07/22/14 15:40	07/23/14 15:45	1

Method: A-01-R - Isotopic Thorium (Alpha Spectrometry)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Thorium-228	0.202	J	0.104	0.106	1.00	0.137	pCi/Sample	07/22/14 11:27	07/28/14 15:25	1
Thorium-230	0.426	J	0.115	0.120	1.00	0.0570	pCi/Sample	07/22/14 11:27	07/28/14 15:25	1
Thorium-232	0.0593	J	0.0419	0.0422	1.00	0.0222	pCi/Sample	07/22/14 11:27	07/28/14 15:25	1

Tracer	%Yield	Qualifier	Limits	Prepared	Analyzed	Dil Fac
Thorium-229	100		30 - 110	07/22/14 11:27	07/28/14 15:25	1

Method: A-01-R - Isotopic Uranium (Alpha Spectrometry)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Uranium-233/234	0.0584	U	0.0553	0.0555	1.00	0.0799	pCi/Sample	07/22/14 11:27	07/28/14 15:29	1
Uranium-235/236	0.0207	U	0.0293	0.0294	1.00	0.0311	pCi/Sample	07/22/14 11:27	07/28/14 15:29	1
Uranium-238	0.0499	U	0.0526	0.0528	1.00	0.0797	pCi/Sample	07/22/14 11:27	07/28/14 15:29	1

Tracer	%Yield	Qualifier	Limits	Prepared	Analyzed	Dil Fac
Uranium-232	88.6		30 - 110	07/22/14 11:27	07/28/14 15:29	1

HVG 21 Aug 14

Client Sample ID: WAA-04-AF-PS-20140710
Date Collected: 07/10/14 13:51
Date Received: 07/14/14 13:10

Lab Sample ID: 160-7447-4
Matrix: Filter

Method: 9315 - Total Apha Radium (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Total Alpha Radium	0.766	U	0.632	0.636	1.00	0.971	pCi/Sample	07/22/14 15:40	07/23/14 15:46	1

Carrier	%Yield	Qualifier	Limits	Prepared	Analyzed	Dil Fac
Ba Carrier	102		40 - 110	07/22/14 15:40	07/23/14 15:46	1

Method: A-01-R - Isotopic Thorium (Alpha Spectrometry)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Thorium-228	0.210	J	0.123	0.124	1.00	0.174	pCi/Sample	07/22/14 11:27	07/28/14 15:25	1
Thorium-230	0.433	J	0.125	0.130	1.00	0.0892	pCi/Sample	07/22/14 11:27	07/28/14 15:25	1
Thorium-232	0.0287	U	0.0609	0.0610	1.00	0.111	pCi/Sample	07/22/14 11:27	07/28/14 15:25	1

Tracer	%Yield	Qualifier	Limits	Prepared	Analyzed	Dil Fac
Thorium-229	90.7		30 - 110	07/22/14 11:27	07/28/14 15:25	1

Method: A-01-R - Isotopic Uranium (Alpha Spectrometry)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Uranium-233/234	0.0829	J	0.0620	0.0624	1.00	0.0794	pCi/Sample	07/22/14 11:27	07/28/14 15:29	1
Uranium-235/236	0.0206	U	0.0292	0.0292	1.00	0.0309	pCi/Sample	07/22/14 11:27	07/28/14 15:29	1
Uranium-238	0.0579	J	0.0438	0.0440	1.00	0.0248	pCi/Sample	07/22/14 11:27	07/28/14 15:29	1

Tracer	%Yield	Qualifier	Limits	Prepared	Analyzed	Dil Fac
Uranium-232	84.0		30 - 110	07/22/14 11:27	07/28/14 15:29	1

Client Sample ID: WAA-05-AF-PS-20140710
Date Collected: 07/10/14 14:51
Date Received: 07/14/14 13:10

Lab Sample ID: 160-7447-5
Matrix: Filter

Method: 9315 - Total Apha Radium (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Total Alpha Radium	0.163	U	0.487	0.488	1.00	0.891	pCi/Sample	07/22/14 15:40	07/23/14 15:46	1

Carrier	%Yield	Qualifier	Limits	Prepared	Analyzed	Dil Fac
Ba Carrier	100		40 - 110	07/22/14 15:40	07/23/14 15:46	1

Method: A-01-R - Isotopic Thorium (Alpha Spectrometry)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Thorium-228	0.225	J	0.119	0.121	1.00	0.163	pCi/Sample	07/22/14 11:27	07/28/14 15:25	1
Thorium-230	0.266	J	0.0909	0.0936	1.00	0.0233	pCi/Sample	07/22/14 11:27	07/28/14 15:25	1
Thorium-232	0.00863	U	0.0490	0.0490	1.00	0.0991	pCi/Sample	07/22/14 11:27	07/28/14 15:25	1

Tracer	%Yield	Qualifier	Limits	Prepared	Analyzed	Dil Fac
Thorium-229	96.8		30 - 110	07/22/14 11:27	07/28/14 15:25	1

HVG 21 Aug 14

Client Sample Results

Client: Tetra Tech EM Inc
Project/Site: West Lake Landfill - Filters

TestAmerica Job ID: 160-7447-1

Client Sample ID: WAA-05-AF-PS-20140710
Date Collected: 07/10/14 14:51
Date Received: 07/14/14 13:10

Lab Sample ID: 160-7447-5
Matrix: Filter

Method: A-01-R - Isotopic Uranium (Alpha Spectrometry)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Uranium-233/234	0.0580	U U	0.0549	0.0552	1.00	0.0793	pCi/Sample	07/22/14 11:27	07/28/14 15:29	1
Uranium-235/236	0.0206	U U	0.0292	0.0292	1.00	0.0309	pCi/Sample	07/22/14 11:27	07/28/14 15:29	1
Uranium-238	0.0827	J	0.0523	0.0527	1.00	0.0248	pCi/Sample	07/22/14 11:27	07/28/14 15:29	1

Tracer	%Yield	Qualifier	Limits	Prepared	Analyzed	Dil Fac
Uranium-232	85.3		30 - 110	07/22/14 11:27	07/28/14 15:29	1

Client Sample ID: WAA-00-AF-FB-20140710
Date Collected: 07/10/14 00:00
Date Received: 07/14/14 13:10

Lab Sample ID: 160-7447-6
Matrix: Filter

Method: 9315 - Total Apha Radium (GFPC)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Total Alpha Radium	0.644	U	0.612	0.615	1.00	0.967	pCi/Sample	07/22/14 15:40	07/23/14 15:47	1

Carrier	%Yield	Qualifier	Limits	Prepared	Analyzed	Dil Fac
Ba Carrier	101		40 - 110	07/22/14 15:40	07/23/14 15:47	1

Method: A-01-R - Isotopic Thorium (Alpha Spectrometry)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Thorium-228	0.213	J	0.111	0.113	1.00	0.151	pCi/Sample	07/22/14 11:27	07/28/14 15:25	1
Thorium-230	0.285	J	0.103	0.106	1.00	0.0989	pCi/Sample	07/22/14 11:27	07/28/14 15:25	1
Thorium-232	0.0367	U	0.0441	0.0442	1.00	0.0704	pCi/Sample	07/22/14 11:27	07/28/14 15:25	1

Tracer	%Yield	Qualifier	Limits	Prepared	Analyzed	Dil Fac
Thorium-229	96.4		30 - 110	07/22/14 11:27	07/28/14 15:25	1

Method: A-01-R - Isotopic Uranium (Alpha Spectrometry)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Uranium-233/234	0.154	J	0.0764	0.0775	1.00	0.0654	pCi/Sample	07/22/14 11:27	07/28/14 15:29	1
Uranium-235/236	0.0319	J	0.0368	0.0369	1.00	0.0319	pCi/Sample	07/22/14 11:27	07/28/14 15:29	1
Uranium-238	0.0853	J	0.0539	0.0544	1.00	0.0256	pCi/Sample	07/22/14 11:27	07/28/14 15:29	1

Tracer	%Yield	Qualifier	Limits	Prepared	Analyzed	Dil Fac
Uranium-232	87.0		30 - 110	07/22/14 11:27	07/28/14 15:29	1

HVG
21 Aug 14

Method: 9315 - Total Apha Radium (GFPC)

Lab Sample ID: MB 160-133148/1-A
Matrix: Filter
Analysis Batch: 133476

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 133148

Analyte	MB Result	MB Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Total Alpha Radium	0.6548	U	0.603	0.606	1.00	0.929	pCi/Sample	07/22/14 15:40	07/23/14 15:43	1

Carrier	MB %Yield	MB Qualifier	Limits	Prepared	Analyzed	Dil Fac
Ba Carrier	74.6		40 - 110	07/22/14 15:40	07/23/14 15:43	1

Lab Sample ID: LCS 160-133148/2-A
Matrix: Filter
Analysis Batch: 133476

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 133148

Analyte	Spike Added	LCS Result	LCS Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	%Rec	%Rec. Limits
Total Alpha Radium	45.0	38.40		4.95	1.00	1.56	pCi/Samp	85	65 - 150

Carrier	LCS %Yield	LCS Qualifier	Limits
Ba Carrier	51.6		40 - 110

Lab Sample ID: LCSD 160-133148/3-A
Matrix: Filter
Analysis Batch: 133476

Client Sample ID: Lab Control Sample Dup
Prep Type: Total/NA
Prep Batch: 133148

Analyte	Spike Added	LCSD Result	LCSD Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	%Rec	%Rec. Limits	RER	RER Limit
Total Alpha Radium	45.0	38.92		4.68	1.00	1.09	pCi/Samp	87	65 - 150	0.05	1

Carrier	LCSD %Yield	LCSD Qualifier	Limits
Ba Carrier	93.8		40 - 110

Method: A-01-R - Isotopic Thorium (Alpha Spectrometry)

Lab Sample ID: MB 160-133096/1-A
Matrix: Filter
Analysis Batch: 134485

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 133096

Analyte	MB Result	MB Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Thorium-228	0.1909		0.121	0.122	1.00	0.176	pCi/Sample	07/22/14 11:27	07/28/14 15:25	1
Thorium-230	0.4099		0.118	0.123	1.00	0.0760	pCi/Sample	07/22/14 11:27	07/28/14 15:25	1
Thorium-232	0.007899	U	0.0274	0.0274	1.00	0.0604	pCi/Sample	07/22/14 11:27	07/28/14 15:25	1

Tracer	MB %Yield	MB Qualifier	Limits	Prepared	Analyzed	Dil Fac
Thorium-229	93.9		30 - 110	07/22/14 11:27	07/28/14 15:25	1

Method: A-01-R - Isotopic Thorium (Alpha Spectrometry) (Continued)

Lab Sample ID: LCS 160-133096/2-A
Matrix: Filter
Analysis Batch: 134486

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 133096

Analyte	Spike Added	LCS Result	LCS Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	%Rec	%Rec. Limits
Thorium-230	17.3	19.37		1.80	1.00	0.0590	pCi/Samp	112	81 - 118

Tracer	*LCS %Yield*	*LCS Qualifier*	*Limits*
Thorium-229	*89.7*		*30 - 110*

Lab Sample ID: LCSD 160-133096/3-A
Matrix: Filter
Analysis Batch: 134487

Client Sample ID: Lab Control Sample Dup
Prep Type: Total/NA
Prep Batch: 133096

Analyte	Spike Added	LCSD Result	LCSD Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	%Rec	%Rec. Limits	RER	RER Limit
Thorium-230	17.3	17.25		1.62	1.00	0.0226	pCi/Samp	100	81 - 118	0.62	1

Tracer	*LCSD %Yield*	*LCSD Qualifier*	*Limits*
Thorium-229	*94.5*		*30 - 110*

Method: A-01-R - Isotopic Uranium (Alpha Spectrometry)

Lab Sample ID: MB 160-133097/1-A
Matrix: Filter
Analysis Batch: 134502

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 133097

Analyte	MB Result	MB Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Uranium-233/234	-0.01758	U	0.0556	0.0556	1.00	0.127	pCi/Sample	07/22/14 11:27	07/28/14 15:29	1
Uranium-235/236	0.01094	U	0.0379	0.0379	1.00	0.0837	pCi/Sample	07/22/14 11:27	07/28/14 15:29	1
Uranium-238	0.04387	U	0.0464	0.0466	1.00	0.0671	pCi/Sample	07/22/14 11:27	07/28/14 15:29	1

Tracer	*MB %Yield*	*MB Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Uranium-232	*83.3*		*30 - 110*	*07/22/14 11:27*	*07/28/14 15:29*	*1*

Lab Sample ID: LCS 160-133097/2-A
Matrix: Filter
Analysis Batch: 134503

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 133097

Analyte	Spike Added	LCS Result	LCS Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	%Rec	%Rec. Limits
Uranium-233/234	25.5	25.20		2.32	1.00	0.0270	pCi/Samp	99	84 - 120
Uranium-238	26.0	26.24		2.41	1.00	0.0687	pCi/Samp	101	82 - 122

Tracer	*LCS %Yield*	*LCS Qualifier*	*Limits*
Uranium-232	*79.3*		*30 - 110*

Method: A-01-R - Isotopic Uranium (Alpha Spectrometry) (Continued)

Lab Sample ID: LCSD 160-133097/3-A
Matrix: Filter
Analysis Batch: 134504

Client Sample ID: Lab Control Sample Dup
Prep Type: Total/NA
Prep Batch: 133097

Analyte			Spike Added	LCSD Result	LCSD Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	%Rec	%Rec. Limits	RER	RER Limit
Uranium-233/234			25.5	25.27		2.34	1.00	0.0910	pCi/Samp	99	84 - 120	0.01	1
Uranium-238			26.0	26.16		2.41	1.00	0.0726	pCi/Samp	100	82 - 122	0.01	1

Tracer	*LCSD %Yield*	*LCSD Qualifier*	*Limits*
Uranium-232	*78.0*		*30 - 110*

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Prep Batch: 133096

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
160-7447-1	WAA-01-AF-PS-20140710	Total/NA	Filter	ExtChrom	
160-7447-2	WAA-02-AF-PS-20140710	Total/NA	Filter	ExtChrom	
160-7447-3	WAA-03-AF-PS-20140710	Total/NA	Filter	ExtChrom	
160-7447-4	WAA-04-AF-PS-20140710	Total/NA	Filter	ExtChrom	
160-7447-5	WAA-05-AF-PS-20140710	Total/NA	Filter	ExtChrom	
160-7447-6	WAA-00-AF-FB-20140710	Total/NA	Filter	ExtChrom	
LCS 160-133096/2-A	Lab Control Sample	Total/NA	Filter	ExtChrom	
LCSD 160-133096/3-A	Lab Control Sample Dup	Total/NA	Filter	ExtChrom	
MB 160-133096/1-A	Method Blank	Total/NA	Filter	ExtChrom	

Prep Batch: 133097

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
160-7447-1	WAA-01-AF-PS-20140710	Total/NA	Filter	ExtChrom	
160-7447-2	WAA-02-AF-PS-20140710	Total/NA	Filter	ExtChrom	
160-7447-3	WAA-03-AF-PS-20140710	Total/NA	Filter	ExtChrom	
160-7447-4	WAA-04-AF-PS-20140710	Total/NA	Filter	ExtChrom	
160-7447-5	WAA-05-AF-PS-20140710	Total/NA	Filter	ExtChrom	
160-7447-6	WAA-00-AF-FB-20140710	Total/NA	Filter	ExtChrom	
LCS 160-133097/2-A	Lab Control Sample	Total/NA	Filter	ExtChrom	
LCSD 160-133097/3-A	Lab Control Sample Dup	Total/NA	Filter	ExtChrom	
MB 160-133097/1-A	Method Blank	Total/NA	Filter	ExtChrom	

Prep Batch: 133148

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
160-7447-1	WAA-01-AF-PS-20140710	Total/NA	Filter	DPS-0	
160-7447-2	WAA-02-AF-PS-20140710	Total/NA	Filter	DPS-0	
160-7447-3	WAA-03-AF-PS-20140710	Total/NA	Filter	DPS-0	
160-7447-4	WAA-04-AF-PS-20140710	Total/NA	Filter	DPS-0	
160-7447-5	WAA-05-AF-PS-20140710	Total/NA	Filter	DPS-0	
160-7447-6	WAA-00-AF-FB-20140710	Total/NA	Filter	DPS-0	
LCS 160-133148/2-A	Lab Control Sample	Total/NA	Filter	DPS-0	
LCSD 160-133148/3-A	Lab Control Sample Dup	Total/NA	Filter	DPS-0	
MB 160-133148/1-A	Method Blank	Total/NA	Filter	DPS-0	

Tracer/Carrier Summary

Client: Tetra Tech EM Inc.
Project/Site: West Lake Landfill - Filters

TestAmerica Job ID: 160-7447-1

Method: 9315 - Total Apha Radium (GFPC)

Matrix: Filter

Prep Type: Total/NA

		Percent Yield (Acceptance Limits)
		Ba
Lab Sample ID	Client Sample ID	(40-110)
160-7447-1	WAA-01-AF-PS-20140710	101
160-7447-2	WAA-02-AF-PS-20140710	100
160-7447-3	WAA-03-AF-PS-20140710	99.7
160-7447-4	WAA-04-AF-PS-20140710	102
160-7447-5	WAA-05-AF-PS-20140710	100
160-7447-6	WAA-00-AF-FB-20140710	101
LCS 160-133148/2-A	Lab Control Sample	51.6
LCSD 160-133148/3-A	Lab Control Sample Dup	93.8
MB 160-133148/1-A	Method Blank	74.6

Tracer/Carrier Legend

Ba = Ba Carrier

Method: A-01-R - Isotopic Thorium (Alpha Spectrometry)

Matrix: Filter

Prep Type: Total/NA

		Percent Yield (Acceptance Limits)
		Th-229
Lab Sample ID	Client Sample ID	(30-110)
160-7447-1	WAA-01-AF-PS-20140710	95.1
160-7447-2	WAA-02-AF-PS-20140710	95.4
160-7447-3	WAA-03-AF-PS-20140710	100
160-7447-4	WAA-04-AF-PS-20140710	90.7
160-7447-5	WAA-05-AF-PS-20140710	96.8
160-7447-6	WAA-00-AF-FB-20140710	96.4
LCS 160-133096/2-A	Lab Control Sample	89.7
LCSD 160-133096/3-A	Lab Control Sample Dup	94.5
MB 160-133096/1-A	Method Blank	93.9

Tracer/Carrier Legend

Th-229 = Thorium-229

Method: A-01-R - Isotopic Uranium (Alpha Spectrometry)

Matrix: Filter

Prep Type: Total/NA

		Percent Yield (Acceptance Limits)
		U-232
Lab Sample ID	Client Sample ID	(30-110)
160-7447-1	WAA-01-AF-PS-20140710	86.3
160-7447-2	WAA-02-AF-PS-20140710	83.6
160-7447-3	WAA-03-AF-PS-20140710	88.6
160-7447-4	WAA-04-AF-PS-20140710	84.0
160-7447-5	WAA-05-AF-PS-20140710	85.3
160-7447-6	WAA-00-AF-FB-20140710	87.0
LCS 160-133097/2-A	Lab Control Sample	79.3
LCSD 160-133097/3-A	Lab Control Sample Dup	78.0
MB 160-133097/1-A	Method Blank	83.3

Tracer/Carrier Legend

U-232 = Uranium-232